

The NASA SCI Files™
The Case of the Ocean Odyssey

Segment 4



The tree house detectives think they are almost ready to solve the mystery but become concerned over the environmental impact that the oil has on their community and wildlife. They dial-up a NASA SCI Files™ Kids' Club at Key Largo School in Key Largo, Florida, where members are conducting an experiment to learn more about cleaning up an oil spill. After discovering that cleaning up oil is not an easy job, RJ goes to NASA Wallops Flight Facility to talk with Ms. Sue Fields and Dr. John Moisan. Ms. Fields explains the environmental impact of oil, why it is so important to contain an oil spill before it reaches land, and who is responsible for the cleanup. Dr. Moisan helps the detectives put the final pieces together to solve the mystery as he explains coastal currents. Finally, it is off to Dr. D's lab where the tree house detectives wrap it up and get confirmation on their hypothesis. Another case solved!

Objectives

Students will

- understand convection currents.
- demonstrate the movement caused by dispersion.
- demonstrate the effectiveness of various methods of oil spill cleanup.
- identify the sources of oil pollution in the ocean.
- learn the difference between immiscible and miscible.
- learn how an oil spill affects sediment.
- explain the impact of oil pollution on the environment.
- learn about surface currents.

Vocabulary

absorbents—materials capable of soaking up liquids such as oil

boom—a floating barrier used to confine or restrict an oil spill

coastal currents—density or surface currents located along or near the coast, such as long-shore currents, rip tides, upwellings, and downwellings

dispersion—the scattering of something within an area or space

eddy—a movement in a flowing stream of liquid or gas in which the current doubles back to form a small whirl

EPA—The Environmental Protection Agency leads the nation's environmental science, research, and assessment

efforts and works to develop and enforce regulations that implement environmental laws enacted by Congress.

filament—winding pieces of a flowing stream that separate from the current

skimmer—a bowl-shaped object or device used to skim oil from the surface of the water

tar balls—globes of thick, sticky, black oil

U.S. Coast Guard—a branch of the military service that enforces maritime laws, acts in marine emergencies, and maintains navigational aids in wartime to supplement the Navy operations.

Video Component

Implementation Strategy

The NASA SCI Files™ is designed to enhance and enrich existing curriculum. Two to three days of class time are suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 4 of *The Case of the Ocean Odyssey*, discuss the previous segment to review the problem and what the tree house detectives have learned thus far. Download a copy of the **Problem Board** from the NASA SCI Files™ web site, select **Educators**, and click on the **Tools** section. The **Problem Board** can also be found in the **Problem-Solving Tools** section of the latest online investigation. Have students use it to sort the information learned so far.
2. Review the list of questions and issues that the students created prior to viewing Segment 3 and determine which, if any, were answered in the video or in the students' own research.
3. Revise and correct any misconceptions that may have been dispelled during Segment 3. Use tools located on the Web, as was previously mentioned in Segment 1.
4. Review the list of ideas and additional questions that were created after viewing Segment 3.

5. Read the overview for Segment 4 and have students add any questions to their lists that will help them better understand the problem.

6. **Focus Questions**—Print the questions from the web site ahead of time for students to copy into their science journals. Encourage students to take notes during the program to answer the questions. An icon will appear when the answer is near.

View Segment 4 of the Video

For optimal educational benefit, view *The Case of the Ocean Odyssey* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. At the end of Segment 4, lead students in a discussion of the Focus Questions for Segment 4.
2. Have students discuss and reflect upon the process that the tree house detectives used to learn more about the future of space exploration. The following instructional tools located in the **Educators** area of the web site may aid in the discussion: **Experimental Inquiry Process Flowchart** and/or **Scientific Method Flowchart**.



Careers

ecologist
environmentalist
environmental
engineer
marine science
technician
pollution control
technician
sailor

3. Choose activities from the **Educator Guide** and web site to reinforce concepts discussed in the segment. Pinpoint areas in your curriculum that may need to be reinforced and use activities to aid student understanding in those areas.

4. For related activities from previous programs, download the **Educator Guide**. On the NASA SCI Files™ home page, select **Educators**. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Wacky Water Cycle*. In the green box, click on **Download the Educator Guide**.

a. In the **Educator Guide** you will find

a. **Segment 3** – *One in a Million*

b. **Segment 3** – *To Still Water*

Close the PDF window and return to the **Educator Guide** page. Click on **Episodes** in the menu bar at the top. Scroll down to the 2003–2004 Season and click on *The Case of the Disappearing Dirt*. In the green box, click on **Download the Educator Guide**.

a. In the Educator Guide you will find

a. **Segment 4** – *Shifty Sand*

b. **Segment 4** – *To Erode or To Deposit, That Is the Question*

5. Wrap up the featured online PBL investigation. Evaluate the students' or teams' final product, generated to represent the online PBL investigation. Sample evaluation tools can be found in the **Educators** area of the web site under the main menu topic **Tools** by clicking on **Instructional Tools**.
6. Have students write in their journals what they have learned about oceans, currents, oil, and oil spills so they can share with a partner or the class.

Resources (additional resources located on web site)

Books

Cherry, Lynne: *A River Ran Wild: An Environmental History*. Harcourt, Brace, and Company, 2002, ISBN: 0152163727.

Day, Trevor: *Popular Science Datafiles: Ocean*. Silver Dolphin Books, 2001, ISBN: 1571454802.

D'Lacey, Chris: *Break in the Chain*. Crabtree Publishing, 2002, ISBN: 0778709779.

O'Neill, Michael Patrick: *Fishy Friends: A Journey Through the Coral Kingdom*. Batfish Books, 2003, ISBN: 0972865306.

Parker, Steve: *Eyewitness: Seashore*. DK Publishing, Inc., 2000, ISBN: 0789458268.

Parker, Steve: *Seashore: A BBC Fact Finders Book*. BBC Worldwide Americas, 1997, ISBN: 0563344113.

Pringle, Laurence: *Oil Spills, Volume 1*. Morrow, William, and Company, 1993, ISBN: 0688098614.

Smith, Roland: *Sea Otter Rescue, the Aftermath of an Oil Spill*. Puffin, 1999, ISBN: 014056621X.

Video

Discovery School: *Earth's Waters*
Grades 3–6

Discovery School: *Finite Oceans*
Grades 6–12

Schlessinger Media: *Clean Water*
Grades 4–adult

Warner Brothers Family: *Free Willy 2*
Grades 3–adult

Web Sites

The Exxon Valdez Oil Spill

This site is a comprehensive resource for information regarding the Exxon Valdez Oil Spill. You will find information ranging from the grounding of the vessel to the current status of Prince William Sound.

<http://library.thinkquest.org/10867/>

Oil Spills

NOAA's web site about oil spills. Learn what an oil spill is, how one is cleaned up, and see what activities you can do to learn more about oil spills. There are also links to other web sites about oil spills.

<http://response.restoration.noaa.gov/kids/kids.html>

Global Marine Oil Pollution Information Gateway

This web site is a collection from several agencies and organizations that work to prevent discharges of oils into the marine and coastal environment. The site also offers educational material and special activities for children and students. The overall purpose of these efforts is to make young people familiar with the marine environment, to teach them to care about it, and to understand the consequences of abusing it. Several of the educational web sites also contain practical experiments for students to learn about the behavior and effects of oil in the marine environment.

<http://oils.gpa.unep.org/kids/kids.htm>

United States Environmental Protection Agency

Visit this web site to learn about oil spill characteristics, how to clean up oil spills, oil spill responses, as well as seeing pictures and experiments you can try at home to learn more about oil spills.

<http://www.epa.gov/oilspill/eduhome.htm>

Marine Debris

Human beings not only pollute the ocean with oil, but also with trash. This web site has coloring activities for kids so they can learn how we can stop polluting the oceans.

<http://www.yoto98.noaa.gov/books/debris/debris1.htm>

Human Impact on Oceans

Visit this web site to learn about the impact human beings have on oceans—from oil spills, to dredging, to other forms of pollution.

<http://www.eco-pros.com/humanimpact.htm>

NASA Wallops Flight Facility

Established in 1945 under NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), Wallops Flight Facility—one of the oldest launch sites in the world—is on Virginia's Eastern Shore. Our support of scientific research and orbital and suborbital payloads places us at the center of NASA's Space and Earth Sciences initiative.

<http://www.wff.nasa.gov/index.html>

Office of Naval Research: Oceanography

Visit this web site to learn about oceans in motion, including tides, currents, habitats, ocean life, ocean water, ocean regions, research vessels, and more.

<http://www.onr.navy.mil/focus/ocean/default.htm>

Activities and Worksheets

In the Guide**Dispersing Dispersion**

Create a mini ocean and discover hidden movement. 67

Don't Be Crude

Use skimmers, booms, detergents, and more to clean an oil spill. 69

Graphically Speaking

Create a graph to show the causes of oil pollution. 73

Ocean in a Bottle

Create an ocean spill in a bottle and watch the effects of detergent. 76

Dirty Oil, Oily Dirt

Discover the effects that various densities of oil have on different sediments. 78

There's Oil in My Eggs

Drop some eggs in an oil spill and see what happens. 79

Blowin' Up a Storm of Oil

Create a stormy ocean to learn how oil spills behave in windy conditions. 81

Ocean Odyssey Word Find

Dive into this word find to find a few ocean words. 83

Answer Key

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84

On the Web**Convection Currents**

Learn how temperature creates convection currents.



Dispersing Dispersion

Segment 4

Purpose

To demonstrate the movement caused by dispersion

Background

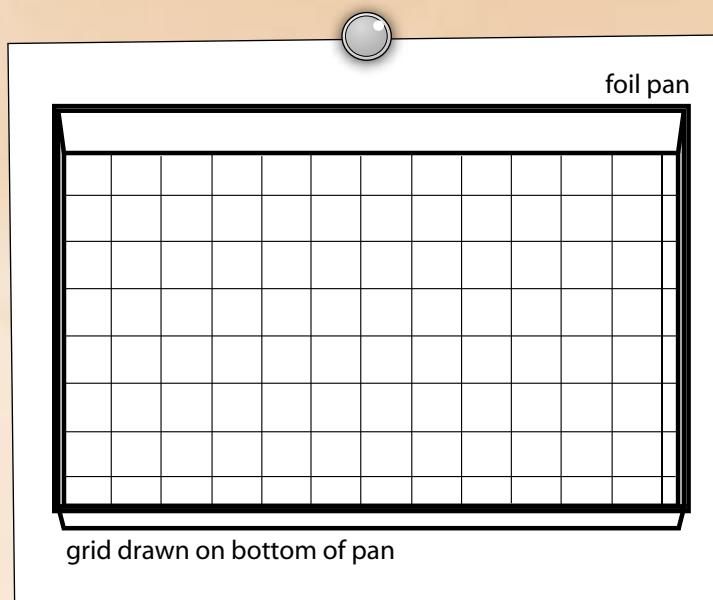
Dispersion is the random movement of objects. This movement is generated by things such as moving air or water molecules that bump into objects, causing them to begin moving randomly. Eventually, the objects will spread out in an even pattern.

Procedure

1. Using the metric ruler and permanent marker, draw a grid on the inside bottom of the foil pan. Make sure the squares on the grid are approximately the same size.
2. Label each square with a grid coordinate (A1, A2, A3, B1, B2, B3, and so on)
3. Fill the pan with water.
4. Place the pan of water where it will be undisturbed.
5. Use the markers to label each cork.
6. Put the corks into the center of the pan of water.
7. In your science journal, draw and label a diagram of the grid in the pan.
8. Using colored pencils, show the location of each cork. *(Note: The corks should be in the center of the pan and more than one cork may be in the same square.)*
9. Predict where you will find the corks when you check the pan the next day.
10. Mark your predictions on the diagram in your science journal.
11. Allow the pan to sit undisturbed overnight.
12. Check the corks the following day.
13. Using a different color pencil, label the new positions of the corks.
14. In your own words, explain what happened to the corks.
15. Leave the corks and examine them again the next day.
16. Record your observations.

Materials

permanent, waterproof
 marker
 rectangular foil pan
 tap water
 8 small corks (or other small
 floating objects)
 metric ruler
 three different colored
 pencils
 science journal



Dispersing Dispersion

Segment 4

Conclusion

1. What happened to the corks in the pan?
2. What caused the movement of the corks?
3. What is dispersion?
4. How can understanding dispersion help the tree house detectives learn more about where the tennis shoes came from?

Extension

On a piece of paper, make a grid so the squares are each at least 2.5 cm. Label each square on the grid with a coordinate pair. Hold a set of toy jacks in your hand above the center of the grid. Drop the jacks. On a sheet of graph paper, mark the location of the jacks with a dot. Be sure to label the x-axis and the y-axis on your graph. Now drop the jacks again. Mark the location of the jacks this time. This kind of diagram can show dispersion patterns. Draw a circle around the area on your graph where most of the jacks fell. The area inside your circle shows the average dispersion pattern for the jacks. Some of the jacks may have fallen far away from the others. The dots used to represent those jacks are called outliers because they don't follow the same general pattern as the others. These dots appear outside the circle. Now try dropping the jacks from a higher distance. Mark your results on the diagram. How do these results compare to the first two trials? What happened to the size of your dispersion pattern? Why do you think it happened?

Don't Be Crude!

Segment 4

Purpose

To demonstrate the effectiveness of various methods of oil spill cleanup
 To understand what a difficult job oil spill cleanup is

Background

Each year millions of liters of oil enter the ocean. Although oil spills are relatively rare and account for only 5% of the total oil in the ocean, their effects on local wildlife and natural ecosystems can be catastrophic. Oil spill cleanup is affected by the type of oil, the source of the oil, the currents that flow in the area, and the condition of the water surface due to weather. Time is an important factor. The more an oil spill spreads, the more damage it can do and the harder it is to clean up. Immediately following an oil spill, attempts are made to contain the oil. Containment by booms, or barriers, keeps the oil from spreading. The use of log booms and floating booms with submerged skirts have been successful on a limited basis. Once the oil is contained, a variety of removal techniques have been used.

- Booms and skimmers contain the oil.
 - The vacuum method is limited to calm water conditions.
 - Absorbents such as straw, sawdust, peat moss, cornstarch may become waterlogged and difficult to remove and will present disposal problems.
 - Absorbents such as synthetics absorb oil, but not water, and again present disposal problems.
 - Burning leaves toxic residue and pollutes air.
 - Newer types of chemical dispersants have greater effectiveness and less toxicity and are designed for very specific uses; they may include gelling agents, emulsifiers, or the use of bacteria to break up the oil.
 - Sinking agents, such as sand, clay, or cement are PROHIBITED in U.S. waters; they sink to the bottom of the seafloor and affect sea life at these levels; natural breakdown of oil is slowed down considerably at these depths, causing longer term problems.
- No current cleanup method is totally successful, but new satellite technology enables us to track the movement of the oil, the currents, and hazardous ocean conditions that can lead to spills.

Materials

(for each group of students)

1 disposable aluminum pie pan
 water
 blue food coloring
 metric measuring spoons
 45-mL vegetable oil
 30-mL pure cocoa powder
 5-mL table salt
 cup for mixing
 a variety of absorbent materials such as cotton balls, paper towels, sponges, nylon stockings, or shredded wheat
 aluminum foil
 foam cups
 newspapers
 a few drops of dishwashing liquid
 wooden craft sticks for stirring
 tweezers or tongs

Don't Be Crude!

Segment 4

Procedure

1. Fill an aluminum pie pan half full of tap water.
2. Stir in 5 mL of table salt.
3. Add 3 or 4 drops of blue food coloring.
4. Mix well with a wooden stirring stick.
5. Let the solution settle.
6. In a cup, mix together 45 mL of vegetable oil and 30 mL of cocoa powder.
7. Stir until well blended. (This mixture represents your crude oil.)
8. Very slowly pour the simulated crude oil onto the top of the pan of water.
9. Observe what happens over the next few minutes.
10. Record your observations in your science journal.
11. Include a diagram that shows the oil spill.
12. Using the chart of oil spill terms, identify the types of oil spills you see.
13. Label your diagram.
14. Your job is to clean up the oil spill.
15. Choose any three of the absorbent materials listed above.
16. Attempt to clean up the oil spill by using the materials you have selected.
17. Place a small sample of one of these materials in the center of the oil spill.
18. Use tweezers or tongs to remove the absorbent material.
19. Using the cleanup chart, record what happens to the material and to the oil spill.
20. Estimate the percent of the oil that was cleaned up by your absorbent material.
21. Try a different absorbent material.
22. Compare the results of this material to the first one you used.
23. Now try adding two drops of dishwashing liquid to your oil spill.
24. Watch quickly to see what happens.
25. Record what you see.
26. You may want to once again try using one or more of the absorbent materials after you have added the detergent.
27. Compare the performance of these materials now to how well they worked when you first used them.
28. Try making a scoop from aluminum foil or from a foam cup.
29. Use the scoop to try to clean up the remainder of the oil spill.
30. Be sure to clean off the scoop after each dip in the water so you do not re-contaminate the water.
31. When you have cleaned up as much of the oil spill as possible, carefully dispose of your materials.

Don't Be Crude!

Segment 4

Conclusion

1. Under what conditions is a boom the most effective way to control an oil spill?
2. How effective were the absorbent materials you chose?
3. What does the absorbent material pick up?
4. How would you pick up the oil-contaminated material in a real oil spill?
5. What would you do with the contaminated materials after they were collected?
6. What impact did the dishwashing liquid have on the oil spill?
7. How effective were your original materials after the dishwashing liquid had been added to the water?
8. What effect might chemical absorbents (like the detergent) have on the ocean environment?
9. What was the most effective way to clean up the oil spill?
10. What are some other factors that might affect the cleanup of an oil spill?

Extension

Try this experiment again using freshwater instead of saltwater in the pan. What differences did you see? Try putting sand on the bottom of your "ocean." What happens to the sand when the contaminants are spilled? Explain why the United States prohibits the use of sinking agents, such as sand, clay, or cement, as ways to clean up oil spills. Do an Internet search to find pictures of oil spills. How do these pictures compare to the oil spill you created?

Glossary of Terms Used To Describe Oil Spills

- Spill characteristics will appear different under low light or strong wind conditions.
- light sheen: a light, almost transparent layer of oil
- silver sheen: a slightly thicker layer of oil that appears silvery or shimmery
- rainbow sheen: a sheen that reflects colors like a rainbow
- brown oil: a 0.1-mm–1.0-mm thick layer of small oil globules in suspension; although thickness may vary, can have a heavy or dull-colored sheen
- mousse: small oil globules in suspension that form as the oil weathers; colors can range from orange or tan to dark brown
- black oil: black colored oil that sometimes has a latex texture
- windows/streaks/stringers/fingers: oil or sheen arranged in lines or streaks
- tar balls: weathered oil that has formed a pliable (or easily shaped) ball; size varies from the size of a pinhead to about 30 cm; sheen may or may not be present
- tar mats: nonfloating mats of oily debris (usually sediment and/or plant matter) that are found on beaches or just offshore
- pancakes: isolated patches of oil shaped in a mostly circular design; range in size from a few meters across to hundreds of meters in diameter; sheen may or may not be present

Don't Be Crude!

Segment 4

Data Sheet for "Don't Be Crude" Observations

Record your observations for each type of material used to clean up the oil spill.

Material	Estimated Oil Cleaned Up (percent)	Comments (i.e., not very effective, effective, left with oily cotton, and so on.)
Absorbent 1:		
Absorbent 2:		
Absorbent 3:		
Dishwashing Liquid		
Absorbent 1:		
Absorbent 2:		
Absorbent 3:		
Skimmer		

Graphically Speaking

Segment 4

Purpose

- To organize data into circle or bar graphs
- To identify the sources of oil pollution in the ocean

Background

When a major oil spill occurs in the United States, teams of local, state, and national personnel work together to contain the spill, clean it up, and minimize the damage to human beings and the environment. Time is a critical factor when dealing with an oil spill. Without careful planning and clear organization, efforts to deal with large oil spills could be slow and ineffective. In the United States, the system for organizing responses to major oil spills is called the National Response System. In 1967, an oil tanker ran aground 15 miles off Land's End, England, spilling 33 million gallons of crude oil into the ocean. The spill had negative impacts on beaches, wildlife, fishing, and tourism as it destroyed 150 miles of coastline in France and England. Recognizing the possibility of a similar spill in the United States, the federal government sent a team of representatives from different federal agencies to Europe to observe the cleanup activities. Based on what the team learned from this spill, a National Contingency Plan (NCP) was developed and signed into law. As part of this law, the National Response System was formed. The National Response Center in Washington, DC, is the first agency to be notified when a major oil spill occurs. The center is staffed by officers and marine science technicians from the U.S. Coast Guard and serves as the national communications center to record oil spill reports and oversee oil cleanup.

Oceans suffer from far more than an occasional devastating spill. Disasters make headlines, but hundreds of millions of gallons of oil quietly end up in the seas every year, mostly from non-accidental sources. Natural seeps, oil runoff from municipal and industrial waste, and even air pollution contribute to the oil pollution found in the ocean.

Materials

- colored pencils
- graph paper
- Oil Spill Fact Sheet (p. 74)
- world map

Procedure

1. You are a marine science technician on the National Response System Team.
2. Examine the data that have been given to you about the source of oil pollution in the ocean waters.
3. Find the total number of gallons of oil that find their way into the oceans each year.
4. Find the percent that each source contributes to oil pollution. To find the percent, remember to divide the number of gallons from a specific source by the total number of gallons of oil.
5. Organize the data into a circle graph to show how much of the total oil pollution comes from each source.
6. Now organize the data about reported oil spills.
7. Make a bar graph to show how much oil spilled into the ocean during each accident.
8. On a world map, mark the location of the major oil spills listed in your Oil Fact Sheet.

Conclusion

1. Why is it important to maintain records about oil spills?
2. Which oil source is responsible for the largest percent of oil pollution in the ocean?
3. Which source contributes the least amount of oil to the pollution problem?
4. What steps can we take to prevent future oil spills?

Extension

Research the structure of an oil tanker. Design a model of a tanker. Pretend you are a worker on an oil tanker. Keep a journal to record your adventures, including the oil spill in which you are involved. Tell about your journey across the ocean and how the National Response Team begins the cleanup process.



Graphically Speaking

OIL SPILL FACT SHEET

SOURCES OF OIL POLLUTION

Major Oil Spills – 37 million gallons

Oil from major tanker accidents accounts for a small percentage of the total oil pollution in the oceans. These spills, however, are often dramatic and can disrupt sea and shore life for miles.

Runoff – 363 million gallons

Used engine oil often finds its way into our oceans. Much oil from land and municipal waste becomes runoff that contaminates waterways and eventually ends up in the ocean. As cars drive over roads, oil may drip from the engines onto the pavement. Sealants used to coat blacktop roads are also oil-based products. When rainwater falls on these oily roads, the oil is washed away. Oily road runoff from a city of 5 million people could contain as much oil as one large tanker spill.

Routine Maintenance – 137 million gallons

Every year bilge cleaning and other ship operations release millions of gallons of oil into ocean waters. Most of these discharges are just a few gallons each.

Air Pollution – 92 million gallons

Air pollution, mainly from cars and industry, releases hundreds of tons of hydrocarbons into the oceans each year. Particles from the pollution settle, and rain washes these hydrocarbons from the air into the oceans.

Natural Seeps – 62 million gallons

Some ocean pollution is natural. Seepage from the ocean bottom may occur. Sedimentary rocks that contain oil may also erode, releasing the oil into ocean waters. Worldwide, the seepage only accounts for 62 million gallons, or about 2% of the oil found in the oceans. In North American oceans, this natural seepage becomes a much more serious problem. Natural seepage accounts for 62% of the oil in North American oceans. The Gulf of Mexico is the greatest natural source of oil in North American waters.

Offshore Drilling – 15 million gallons


Offshore oil production can cause some ocean oil pollution. Spills and operational discharges pour oil directly into the ocean waters. Fortunately, this source of ocean pollution is minimal.

Graphically Speaking

Segment 4

Leading Oil Spills

Oil spills are generally reported according to the number of barrels of oil that are lost in ocean waters. Tens of thousands of oil spills have occurred since the beginning of oil transport; however, few of these spills have been significant.



Date	Cause	Location	Barrels Lost
12/15/1976	<i>Argo Merchant</i> grounded	off SE Massachusetts	182,000
3/16/1976	<i>Amoco Cadiz</i> grounded	off NW France	1,561,000
7/01/1979	<i>Atlantic Empress</i> collided with <i>Aegean Captain</i>	off Trinidad	2,100,000
11/01/1979	<i>Burmah Agate</i> burns after collision	in Galveston Bay, TX	252,000
8/06/1983	Fire aboard <i>Castillo de Beliver</i>	off Cape Town, South Africa	1,750,000
12/06/1985	Drilling rig accident	off Texas Coast	326,000
11/10/1988	Tanker <i>Odyssey</i> grounded	off Newfoundland	1,100,000
3/24/1989	<i>Exxon Valdez</i> grounded	Prince William Sound, Alaska	245,000
4/11/1991	Tanker <i>Haven</i> grounded	off Genoa, Italy	100,000
2/15/1996	<i>Sea Empress</i> grounded	off South Wales, UK	500,000

(Set up a grid for a graph with the ships name on left and numbers from 100,000 to 2,400,000 across the bottom.)

Ocean in a Bottle

Segment 4

Purpose

- To learn the difference between immiscible and miscible
- To see what happens to ocean water during an oil spill
- To see the effect of adding soap to ocean water to clean an oil spill

Background

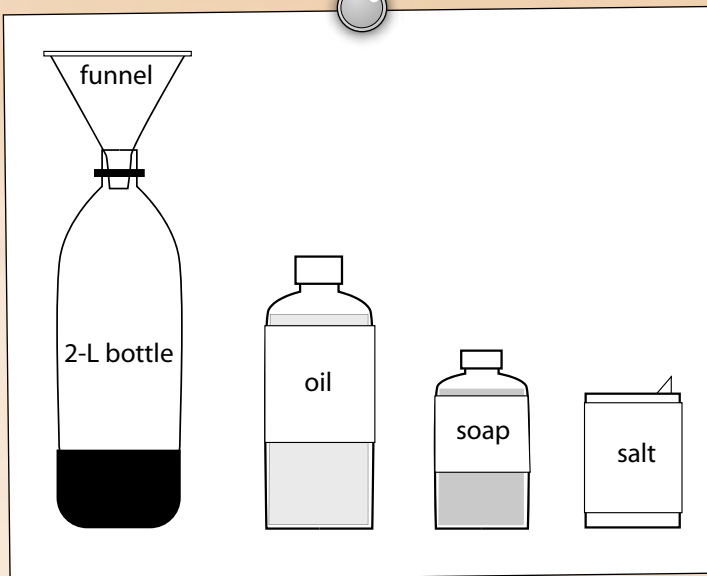
Cleaning up after an oil spill can be a challenging and time-consuming task. Oil is immiscible in water. In other words, oil will not mix with water. When oil spills into the ocean, it will not combine with the ocean water, leaving floating oil globules or sediment oil deposits. All this oil must be cleaned up to reduce the harmful impact it can have on the environment. One method for cleaning up oil is to add detergents to the water. When detergent is added to an oil spill, it has a dramatic effect on the oil, causing it to clump together. The clumping makes the oil easier to remove from the water; however, detergent is miscible in water. In other words, soap will mix, or combine, with water. Adding detergent to water can help remove the oil from the water, but the detergent remains behind. It is almost like trading one pollutant for another.

Materials

3 2-L, clear soda bottles
(cleaned and with label removed)
metric measuring cup
water
vegetable oil
liquid detergent
funnel
paper towels
science journal

Procedure

1. Measure 710 mL of water.
2. Using a funnel, pour the water into one of the 2-L bottles.
3. Measure 25 mL of salt.
4. Using a funnel, pour the salt into the bottle.
5. Gently shake the bottle to mix the water and salt so the mixture represents the ocean.
6. Measure and add 237 mL of vegetable oil to the bottle.
7. Put the cap on the bottle tightly.
8. Observe and record your observations in your science journal.
9. Shake the bottle to mix up the liquids.
10. Observe and record the appearance and behavior of the liquids.
11. With the masking tape and pen, label this bottle "oil."
12. Set the bottle aside and allow it to settle.
13. In another clean, 2-L bottle, add 710 mL of water.
14. Add 25 mL of salt and gently shake to mix.
15. Add 237 mL of liquid detergent.
16. Observe and record.
17. Put the cap on tightly and shake the bottle to mix up the liquids.
18. Observe and record the appearance and behavior of the liquids.
19. Label this bottle "detergent."
20. Set the bottle aside and allow it to settle.



Ocean in a Bottle

Segment 4

21. In the last clean, 2-L bottle, add 710 mL of water.
22. Add 25 mL of salt and gently shake to mix.
23. Add 118 mL of oil and 188 mL of shampoo or liquid laundry detergent.
24. Observe and record.
25. Put the cap on tightly and shake to mix up the liquids.
26. Observe and record the appearance and behavior of the liquids.
27. Label this bottle "oil and detergent."
28. Set the bottle aside and allow it to settle.
29. After the bottles' contents have settled, compare the appearance of the liquids in the 3 bottles.

Conclusion

1. Which liquids were miscible? Which were immiscible?
2. After the bottles were allowed time to settle, was there any change in the liquids?
3. What consequences do you think will come from using detergent to clean up oil spills?
4. Is adding detergent to the water in an attempt to clean up oil a good solution? Why or why not?

Extension

Try to clean up the oil in the 2 bottles that contain oil. Is it easy or hard? Why? Research methods that will clean up oil spills from water. Try some of them. Which ones are most effective? Least effective?

Dirty Oil, Oily Dirt

Segment 4

Purpose

- To demonstrate the different types of oil and sediments
- To learn how sediment is affected in an oil spill

Background

Beaches are composed of sediment. Sediments are pieces of rock that have been weathered and are carried and deposited by the ocean. Sediment types can range from very fine grained particles of such things as clay and mud, to very coarse-grained particles of sand and gravel.

Oil has two general types – heavy or light. Heavy oil is thicker and is used to fuel ships. Light oil is thinner and is used as diesel fuel or light crude oil. When an oil spill occurs in the ocean, oil can wash up on nearby beaches. Oil in sediment is harder to clean up than oil that is on the surface of the water.

Depending on the type of oil and the type of sediment, oil penetration in the sediment will vary. Typically, heavier oil penetrates sediment more slowly than lighter oil does. Finer grained sediment tends to absorb oil more slowly than coarser grained sediment. In this activity, you will conduct an environmentally friendly experiment to see the differences in oil absorption between fine- and coarse-grained sediment and light and heavy oil.

Procedure

1. Fill 1 container 2/3 full of coarse-grained sand.
2. With tape and a pen, label the container “coarse-grained sand.”
3. Fill another container 2/3 full of medium- to fine-grained sand.
4. Label the container “medium- to fine-grained sand.”
5. Fill the remaining container 2/3 full of clay or mud.
6. Label the container “clay” or “mud.”
7. Make an indentation in each sediment type by pressing the bottom of a small glass into 2 places on the surface to create the 2 areas for oil to be applied.
8. Measure equal volumes of molasses and mineral oil.
9. Pour the molasses into one of the indentations in the “coarse-grained sand.”
10. Pour the mineral oil into the other area of the “coarse-grained sand.”
11. Observe and record the behavior of the liquids in your science journal.
12. Repeat steps 8–11 for the other two sediment types.
13. Because this activity is environmentally friendly, all materials can be disposed of normally.

Conclusion

1. What happened when the molasses made contact with the sediments? The mineral oil?
2. Did one of the simulated oils work faster than the other? Why or why not?
3. Was one of the sediment types quicker to absorb the oils? Why or why not?
4. What consequences of this activity compare to real oil spills?

Extension

1. Repeat this experiment with different oil types (vegetable oil, olive oil, peanut oil, etc.) and simulated oil types (maple syrup, chocolate syrup, etc.). Do you get the same results as before? Why or why not?
2. Research methods of cleaning up oil from sediment. Try to clean up some of the oil in your sediment. Which methods worked well and which methods did not work so well?

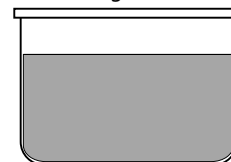
Materials

3 wide-mouth containers
measuring cup
coarse-grained sand or gravel
medium- to fine-grained sand
clay or mud
molasses (*simulates heavy oil*)
mineral oil (*simulates light oil*)
small glass
masking tape
pen
science journal

coarse-grained sand



medium-grained sand



mud



There's Oil in My Eggs

Segment 4

Purpose

To explain the impact of oil pollution on the environment and wildlife

Background

Large oil spills, although they are a relatively minor source of ocean oil pollution, can easily destroy an ecosystem. The same amount of oil can do more damage in some areas than in others. Coral reefs and mangroves are more sensitive to oil than sandy beaches or sea grass beds. Oil-covered fur or feathers can't insulate marine mammals and diving birds from cold water. When an animal cleans itself, it also swallows oil, which may be deadly. Birds with oil-coated feathers are often unable to swim or fly. Smithsonian Institution scientists monitored the effects of a 1986 oil spill in tropical North America. Five years later, mangrove sediments still held fresh, toxic oil. It could take 50 years for the mangrove ecosystem to recover fully from this single incident.

Procedure

Egg

1. Place the hard-boiled eggs (including shells) in a bowl.
2. Cover the eggs with used motor oil. See diagram 1.
3. Mark the time of placement in your science journal.
4. Set the bowl aside for 30 minutes.
5. In your science journal, write down any predictions you have about what will happen to the eggs that are placed in the oil.
6. After 30 minutes, put on the gloves and remove one of the eggs from the oil.
7. Examine and observe the outside of the egg.
8. Record your observations and be sure to include the look and smell of the eggshell.
9. Peel the egg.
10. Examine the egg white and the inside of the shell.
11. Record your observations and note any evidence that the egg was in the oil.
12. Continue to open the egg by splitting it apart to view the yolk.
13. Determine whether the egg yolk shows any evidence of the oil.
14. Record your observations.
15. Read your original prediction and revise your prediction based on the information you have now gathered.
16. Repeat this process with a different egg after one hour, two hours, three hours, and the following day.
17. Compare your observations from the first egg to the last egg.

Feather

18. Select a feather and examine it closely.
19. In your science journal, draw a picture of what you see.
20. Dip the feather in the used motor oil. See diagram 2.
21. Look closely at the feather and observe any changes.
22. Record your observations.
23. Predict how successful various cleaners will be in cleaning the oil from the feather.

Materials

5 hard-boiled eggs
 480-mL used motor oil
 bird feathers (available from a pet store or craft store)
 piece of fake fur material
 magnifying lens
 soap
 clean water
 large bowl
 disposable plastic gloves
 paper towels
 science journal
 clock or timer

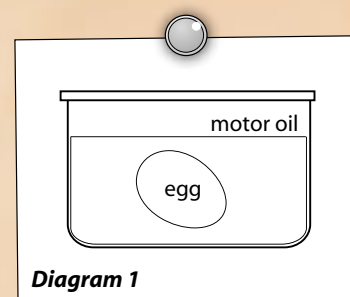


Diagram 1

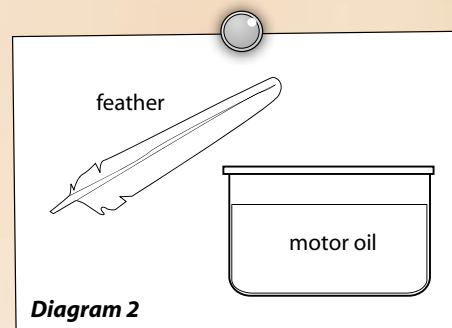


Diagram 2

There's Oil in My Eggs

Segment 4

24. Develop a plan to clean the oil from the feather.
25. Clean the feather following your plan.
26. Record how successful your cleanup efforts were and discuss the results with your group and class.

Conclusion

1. How did the oil affect the eggs?
2. What evidence did you have that the oil had penetrated the eggshell?
3. How did the oil enter the solid egg?
4. What effect did the length of time in the oil have on the eggs?
5. What can the tree house detectives learn from this experiment?
6. How successful were you at removing the oil from the feather?
7. What impact can an oil spill have on the ecosystem?

Extension

1. Using available research, find out about a major oil spill. Most oil spills are measured in the number of barrels lost. One petroleum barrel is equivalent to about 159 L. Determine how many 2-L soda bottles of oil were spilled by the accident you investigated.
2. Locate pictures of oil spills and their effects. Construct a collage to show what damage oil spills can do. Write either an instrumental or vocal musical piece that expresses the dangers of oil spills.

Blowin' Up a Storm of Oil

Segment 4

Purpose

To understand the effect wind has on oil spills

Background

Wind can have a great effect on water. Wind causes waves on the surface of the water and is also responsible for the surface currents that are present in the world's oceans. With strong wind movement, oil spilled in the ocean has a greater chance of being spread over large distances by waves and currents. In this activity, you will learn how wind can create surface currents and how waves move.

Procedure

Surface Currents

1. Fill the shallow baking pan with water.
2. With the hole-punch, punch out approximately 20 circles of construction paper.
3. Put the circles on the surface of the water near the left side of the pan.
4. Blow across the surface of the water. See diagram 1. The motion of the circles represents the motion of oil from an oil spill as the wind blows across the ocean surface.
5. Observe and record the motion of the circles in the water as you blow.
6. Repeat steps 4–5 several times.

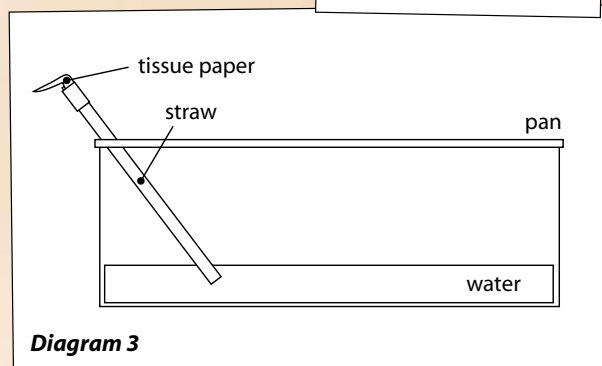
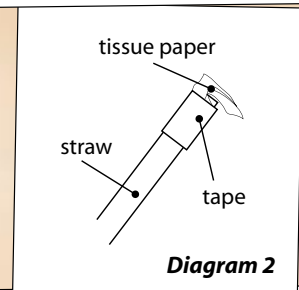
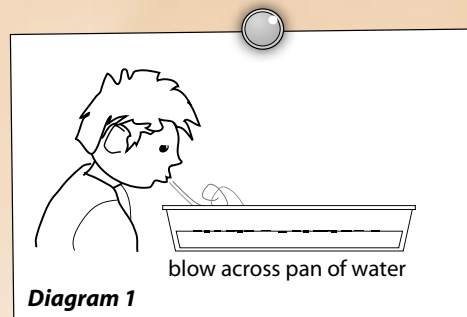
Wave Energy

7. Cut a piece of tissue paper to 2 cm X 0.5 cm.
8. Tape the tissue paper to one end of a straw, leaving the paper hanging from the straw. See diagram 2.
9. Fill the deep pan with water to 2 cm deep.
10. Place the straw in one end of the pan at an angle. See diagram 3.
11. Using your hand, make waves in the water toward the straw.
12. Observe and record the tissue paper at the end of the straw.
13. Remove the straw and fill the pan with water until almost full.
14. With adult supervision, place the fan near the pan. Turn on the fan to low speed and have it blow across the water's surface. See diagram 4 (p. 82)
15. Observe the top of the water and record your observations.
16. Opposite the fan, place the straw in the water as before and observe and record what happens.
17. Place the small piece of foam material in the water. Carefully observe its movement and record your observations.
18. Turn the fan to a higher speed.
19. Observe and record the surface appearance of the water, the tissue, and the piece of foam.

Materials

(per group)

- 1 shallow baking pan
- 1 sheet of dark construction paper
- paper
- hole-punch
- 1 large, deep pan
- 2-speed electric fan
- 1 drinking straw
- 1 piece of tissue paper
- tape
- water
- ruler
- science journal



Blowin' Up a Storm of Oil

Segment 4

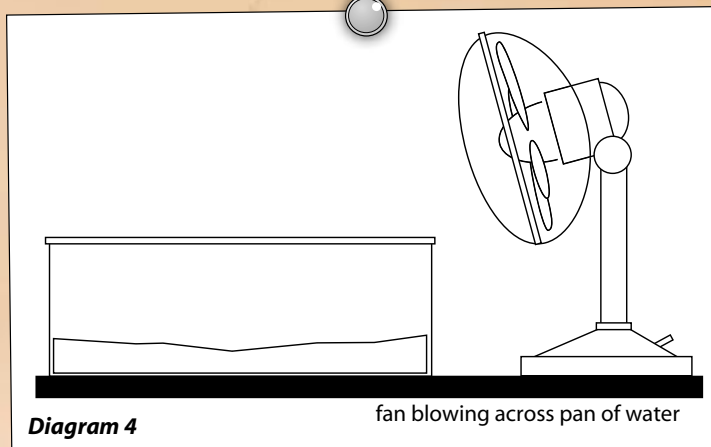
20. Turn off the fan.
21. Measure 60 mL of cooking oil.
22. Mix several drops of blue food coloring into the oil until the oil is dark blue.
23. Slowly pour the blue oil onto the surface of the water.
24. Turn the fan on low. Observe what happens to the oil and record.
25. Turn the fan to a higher speed. Observe and record.

Conclusion

1. What happened to the circles as you blew on the surface of the water?
2. What happened to the tissue paper when you made waves with your hand? When the fan was turned on?
3. What happened to the surface of the water when the fan was turned on?
4. What happened to the piece of foam material when the fan blew on it?
5. What happened to the oil when the fan was turned on?
6. Why would scientists be concerned about strong winds blowing near an oil spill?

Extension

Research to find the main surface currents of the world and make a poster to show them. Explore why learning about surface currents is important. Why might NASA be interested in researching surface currents?



Ocean Odyssey Word Find

Word Find

Using the word bank, circle or highlight the words in the word find.

ocean

surface current

eddy

filament

oil

thermocline

seeps

gas

density current

Gulf Stream

tides

thermohaline

Coriolis effect

permeable

submersible

jack up

oilrig

waves

upwelling

topography

reservoir

O C E A N C A M P R Y N E A P T A M O O N F
 I N M O M G A S S E D I T E J H G U Y I I I
 L A C A M O R P M E T S Y A H E R A E L D G
 R O R D E P E R I A K M C I C R I P A O U N
 I N M A D I O M B N G K M S T M N T H T P E
 G H E E D T I U A I U A G X R O S H S H W O
 O K A I Y O R K N P I N U Y S C I E I Y E U
 I J I L Z E S N M D C C L T U L L R R D L F
 L L P L E T E T E C T O F L B I A M O R L I
 U A I E E E W G E H Z N S N M N E O A S I L
 R S M W R T I A E I T V T U E E R H R T N A
 T Z Q U I C L I V T O E R M R I O A P N G M
 C N L D S A I N D E R R E M S A S L E E H E
 B G E A R S Z A I E S G A O I T P I N R A N
 L I V E R T S S N G P T M C B I A N O R B T
 O S P A C E S T A T I O N T L O C E I U I H
 D E N S I T Y C U R R E N T E N E I T C T E
 I E N E I G P S P E E S K O E S A C I E A R
 E E R T C E F F E S I L O I R O C T R C T I
 A K A T I I T G U D T B I R B I L L T A I N
 R E S E R V O I R D R I R I O Y T I U F R G
 G A E M O H S O B I T E R A T I V E N R U E
 P E R M E A B L E C S N I K K I N Y N U P V
 M F A E B Z X R Y H P A R G O P O T S S R E



Answer Key

Segment 4

Dispersing Dispersion

1. The corks spread out somewhat evenly in the pan.
2. The slightest movement of water and air molecules bumping into the corks caused the corks to begin to move about randomly.
3. Dispersion is the random movement of an object.
4. Dispersion could be a factor in how the tennis shoes washed up on their beach.

Don't Be Crude

1. A boom would be most effective for a small oil spill.
2. Answers will vary.
3. The absorbent material picks up oil and water.
4. In a real oil spill, people might use booms, skimmers, vacuums, absorbents, burning, chemical dispersants, or sinking agents to pick up the oil.
5. The contaminated material must be treated as hazardous waste and disposed of following the appropriate guidelines.
6. The dishwashing liquid made the oil congeal.
7. Answers will vary.
8. The chemical absorbents might add more pollution to the water.
9. Answers will vary.
10. Some of the factors that affect oil spill cleanup include wind, the size and location of the spill, currents, the source of the oil spill, and the condition of the water.

Graphically Speaking

1. Keeping records of oil spills helps us document changes in the environment as a result of the oil spill and may lead to more effective methods to clean up future oil spills.
2. Runoff across the surface area of the land is the source of the largest amount of oil spilled into the ocean.
3. The least amount of oil spill pollution results from offshore drilling.
4. Answers will vary.

Ocean in a Bottle

1. The soap was miscible. The oil was immiscible.
2. In the oil bottle, after some time, the oil returned to float on the surface of the water again. The soap remained mixed with the water.
3. Soap mixes with the water and could become another source of water pollution.
4. Answers will vary.

Sediment Penetration

1. The molasses took more time to absorb into the sediment. The mineral oil absorbed much quicker into the sediment.
2. The mineral oil was faster because it was lighter and flowed more easily.
3. The coarser grained sediment was quicker to absorb the oil than the finer grained sediment because the openings between the grains were larger, allowing the oil to enter more easily.
4. In a real oil spill, oil that reaches the sediment will flow into the sediment more quickly if the sediment is coarse grained. Lighter, more flowing oil will absorb into sediment more quickly than thicker oil that does not flow as easily.

There's Oil in My Eggs

1. The oil is absorbed through the eggshell and ends up in the egg white and egg yolk.
2. The egg white and egg yolk were colored darker by the oil.
3. The tiny openings in the eggshell allowed the oil to enter the egg.
4. The more time that passed, the more oil got into the center of the egg.
5. The Tree House Detectives could learn the effect of an oil spill on wildlife and the environment.
6. Answers will vary.
7. Answers will vary.

Wind Effect on Oil Spills

1. The circles moved around the dish in a clockwise motion.
2. The tissue paper moved when the waves were made and the fan was turned on.
3. The surface of the water formed waves when the fan was turned on.
4. Answers will vary.
5. The oil spread out over the surface of the pan.
6. The strong wind would spread the oil over a greater surface area than if the wind were not there.



Answer Key

Segment 4

Ocean Odyssey Word Find

O C E A N C A M P R Y N E A P T A M O O N F
 I N M O M G A S S E D I T E J H G U Y I I I
 L A C A M O R P M E T S Y A H E R A E L D G
 R O R D E P E R I A K M C I C R I P A O U N
 I N M A D I O M B N G K M S T M N T H T P E
 G H E E D T I U A I U A G X R O S H S H W O
 O K A I Y O R K N P I N U Y S C I E I Y E U
 I J I L Z E S N M D C C L T U L L R R D L F
 L L P L E T E T E C T O F L B I A M O R L I
 U A I E E E E W G E H Z N S N M N E O A S I L
 R S M W R T I A E I T V T U E E R H R T N A
 T Z Q U I C L I V T O E R M R I O A P N G M
 C N L D S A I N D E R R E M S A S L E E H E
 B G E A R S Z A I E S G A O I T P I N R A N
 L I V E R T S S N G P T M C B I A N O R B T
 O S P A C E S T A T I O N T L O C E I U I H
 D E N S I T Y C U R R E N T E N E I T C T E
 I E N E I G P S P E E S K O E S A C I E A R
 E E R T C E F F E S I L O I R O C T R C T I
 A K A T I I T G U D T B I R B I L L T A I N
 R E S E R V O I R D R I R I O Y T I U F R G
 G A E M O H S O B I T E R A T I V E N R U E
 P E R M E A B L E C S N I K K I N Y N U P V
 M F A E B Z X R Y H P A R G O P O T S S R E

On the Web

Convection Currents

1. When the hot water jar was punctured, the hot water rose to the surface because it is less dense than cold water. When the cold water jar was punctured, the cold water sank to the bottom because the cold water is denser than the hot water.
2. After the water sat overnight, the water temperature reached an equilibrium. The water turned purple because the red and blue mixed together.
3. The cold water was denser because it sank to the bottom.
4. Convection currents are currents that form due to uneven water temperatures. The colder water will sink under the warmer water because the colder water is denser.